



Rediscovery of *Chiococca insularis* (Ridley) C.M.Taylor & M.R.V.Barbosa (Rubiaceae), a species presumed extinct, on the island of Fernando de Noronha, Pernambuco, Brazil

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Abstract

Chiococca insularis (Ridley) C.M.Taylor & M.R.V.Barbosa (Rubiaceae) was described by Henry Nicholas Ridley in 1890, based on a collection he made on the island of Fernando de Noronha (Pernambuco, Brazil) in 1887. Since then, this species had not been collected again and has been treated as probably extinct. After 130 years, we discovered two new populations in the southwestern portion of the island, and the conservation status of the species is reassessed. A full description of the species, with previously unseen or unmeasured characters, habitat information and photographs of the plant and environment are provided.

Keywords

Chiococceae, Cinchonoideae, conservation status, endemism, IUCN Red List, threatened species

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Introduction

Rubiaceae are the fourth richest angiosperm family worldwide, with more than 600 genera and ca 13,000 species, and with 38% of them occurring in the Neotropics (Davis et al. 2009; Delprete and Jardim 2012). According to Davis et al. (2009), northern and southeastern Brazil are among the 20 richest regions in the world for Rubiaceae. More than 120 genera and ca 1,400 species occur in the country, with 51% of them endemic (Flora do Brasil 2020).

Chiococca P.Browne (1756) comprises ca 25 Neotropical species of vines, shrubs, and small trees, which are distributed from southeastern North America to northern Argentina, with diversity centers in Mexico, Central America, and the Caribbean region (Jardim et al. 2015; Lorence et al. 2018; Paudyal et al. 2018). Barbosa (2019) reported four species of *Chiococca* in the Brazilian flora. However, according to Paudyal et al. (2018), *Chiococca plowmannii* Delprete (2004), which

is endemic to northeastern coastal Brazil, belongs to *Salzmannia* DC. (Candolle 1830). Therefore, the currently recognized species of *Chiococca* from Brazil are *C. alba* (L.) Hitchc., *C. insularis* (Ridley) C.M.Taylor & M.R.V.Barbosa, and *C. nitida* Benth.

Chiococca insularis is known only from the island of Fernando de Noronha, an oceanic island which is part of the Brazilian state of Pernambuco, and was originally described as *Palicourea insularis* Ridley (1890), based on Ridley's collection from Fernando de Noronha main island between August 14 and September 24, 1887. He reported the presence of only a few individuals in a single location, the Sapata forests. Since then, *C. insularis* has been known only from its type collection, despite an intensive floristic survey carried out by Freitas (2007). Currently it is categorized as Critically Endangered and probably extinct (Zappi et al. 2013).

After 130 years, during fieldwork on Fernando de Noronha (the main island of the Fernando de Noronha Archipelago), we found two new populations of *C. insularis*.

Methods

The island of Fernando de Noronha has an area of 18.4 km² and is in the equatorial south Atlantic Ocean, 350 km east-northeast of Natal (Rio Grande do Norte), and 545 km northeast of Recife (Pernambuco) (Castro 2010). The climate is warm tropical, with annual mean temperature of 26.5 °C and a range of 4 °C. The island has two well-defined seasons: a rainy season from March to July, and a dry season from August to February (Teixeira et al. 2003). The average annual rainfall is 1,418 mm, with a water deficit from August to February (Embrapa 2003). The rainfall, however, can vary significantly from year-to-year and can be more than 2,000 mm or less than 500 mm in some years (Teixeira et al. 2003). The archipelago has no perennial water source, but every year, as in other semi-arid regions, heavy and torrential rains during the rainy season abruptly fill the rivers and creeks, which dry out during the dry season (Ridley 1890; Machado et al. 2013).

While carrying out the Brazilian National Forest Inventory Project (Inventário Florestal Nacional [IFN] in Portuguese) in the state of Pernambuco, a series of plots were allocated on island of Fernando de Noronha. During fieldwork carried out in July 2018, a population of *Chiococca insularis* (03°52'12"S, 032°27'22"W; Fig. 1A, population 1) was found and a specimen with immature fruits was collected. Another population (03°52'26"S, 032°26'54"W; Fig. 1A, population 2) had already been found in September 2016 by one of us, and at that time, the population was recorded only with photos (Fig. 1), as there was no collecting permit.

We identified our collected samples by comparisons with the type specimen deposited at BM (Natural History Museum 2020), study of the taxonomic literature (Ridley 1890; Jardim et al. 2015), and consultation of

online databases (Reflora 2020; INCT-Herbário Virtual 2020). We deposited our collected material in CEN and JPB (acronyms according to Thiers 2019). A full description of the species was prepared, with previously unseen or unmeasured characters included, based on the new samples and the image of the type specimen, calibrated for measurements via the FIJI program (Schindelin et al. 2012).

We evaluated the extinction risk according to the IUCN criteria and guidelines (IUCN 2012, 2019). Area of occupancy (AOO) was calculated using GeoCAT (Geospatial Conservation Assessment Tool, Bachman et al. 2011) and cell width of 0.2 km, due to the small size of the island. Extent of occurrence (EOO) was not estimated, as it does not exceed the size of the island, and the two populations are restricted to a very small and more conserved area in the island's southwest portion.

Results

***Chiococca insularis* (Ridley) C.M.Taylor & M.R.V. Barbosa**, Phytotaxa 202 (1): 18. 2015. *Palicourea insularis* Ridley, J. Linn. Soc., Bot. 27: 41. 1890. *Erithalis insularis* (Ridley) Zappi & T.S.Nunes, Kew Bull. 55: 655. 2000.

Type. BRAZIL. Pernambuco, Fernando de Noronha, main island; 26 Aug. 1887; fl and fr; Ridley, Lea & Ramage 86 (Lectotype, designated by Zappi and Nunes 2000: BM (BM000949953) photo!; isoelectotypes: B destroyed, B as photo F neg. #599 at F (V0069990F), MO-1695030 and NY, GH 00094899 web!, K 000016495 web!, K 000016496 web!).

Figures 2, 3

Material examined. BRAZIL. Pernambuco, Fernando de Noronha, main island; 03°52'12"S, 032°27'22"W, alt. 140 m, 20 Jul. 2018, fr, *Figueira & Schindler 811* (CEN 115006, JPB65084).

Photographic record. BRAZIL. Pernambuco, Fernando de Noronha, main island; 03°52'26"S, 032°26'54"W, alt. 15 m, 13 Sep. 2016, *Jomar G. Jardim*.

Distribution, habitat, and phenology. *Chiococca insularis* is endemic to forests and open scrub vegetation near the seashore on the main island of the Fernando de Noronha Archipelago. It was found with flowers and fruits from June to September. The reproductive period is probably determined by the rainy season, which usually ends in July.

Recommended conservation status. Critically Endangered, B2a, b(i, ii, iii). *Chiococca insularis* is endemic to Fernando de Noronha, with only two known populations within the Parque Nacional Marinho de Fernando de Noronha. The AOO is 0.08 km², much less than 10 km². In addition to the small AOO, the island environment is threatened mainly by population increase in recent decades and losses in the quality of habitat. On the entire

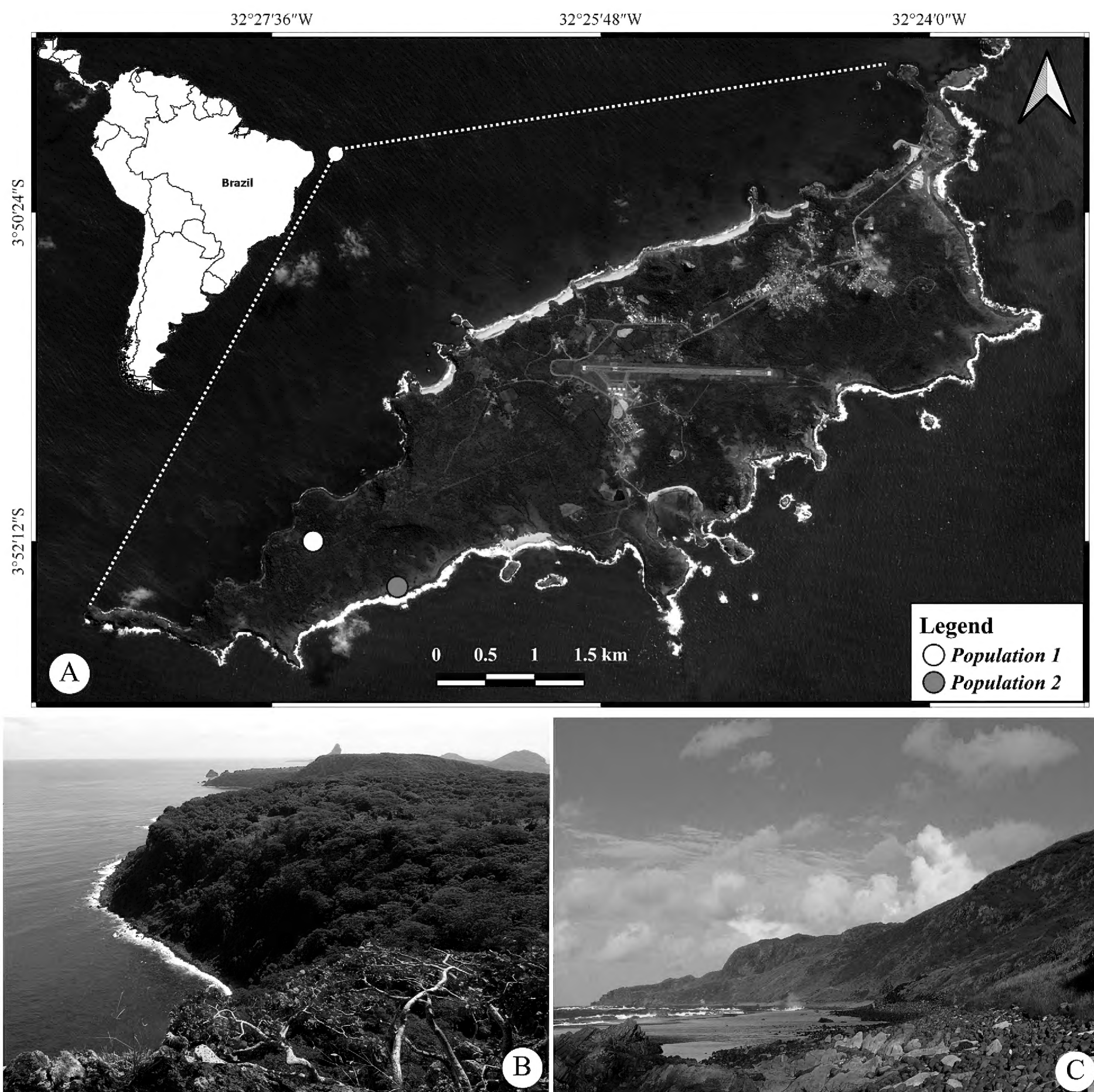


Figure 1. Island of Fernando de Noronha, Pernambuco, Brazil. **A.** Location of the two known populations of *Chiococca insularis*. **B.** Forest in the southwest portion of the island with population 1. **C.** Scrub vegetation with marine influence with population 2. Photographs by Daniel Santiago (B) and BS (C).

island, we noticed the advance of creeping vines and scandent shrubs (i.e. *Jasminum fluminense* Vell., *Plumbago scandens* L., *Cissus verticillata* (L.) Nicolson & C.E.Jarvis, and *Lantana camara* L.) growing over trees and shrubs, and thus preventing the return of the structured condition of the natural vegetation and its ecological benefits. In addition, the island suffers from the introduction of alien tree species, such as *Leucaena leucocephala* (Lam.) de Wit, which grows quickly in both open spaces and the understory of the forest.

Description. Shrubs or treelets, 1–3 m tall; bark grayish; branches erect, rough, glabrous, greenish-brown or yellowish-brown when dried, densely foliate, with scarce resinous exudate at the nodes. Stipules broadly triangular, shortly united around the stem, $2\text{--}3 \times 3\text{--}5$ mm, persistent, glabrous, internally with colleters. Leaves

opposite; blades elliptic to oblanceolate or obovate, $(1.8) 5\text{--}7 \times (0.6) 2\text{--}2.9$ cm, at base decurrent or cuneate, at apex acute, attenuate, cuspidate, or rounded apiculate, margin entire, slightly revolute when dried, chartaceous to coriaceous, glabrous on both surfaces, adaxially shiny; secondary veins 4–5 (6) pairs, eucamptodromous, midrib adaxially flat, abaxially slightly prominent; petioles (1) 3–7 mm long, canaliculate. Inflorescences axillary, paniculiform, lax, up to 10-flowered; peduncle 0.5–1.3 cm long, glabrous; rachis 1.1–3.1 cm long; bracts 1.2–4.2 (5.5) mm long, glabrous, persistent; bracteoles, when present, 0.6–1 mm long. Flowers pedicellate; pedicels 9–17 mm long; calyx cupular, $2.5\text{--}2.7 \times 1.4\text{--}1.9$ mm, lobes 5, acute, glabrous; corolla funnelform, white, glabrous, 5.9–6.7 mm long (including lobes), lobes 5, about equal to the corolla tube at anthesis, a little longer on

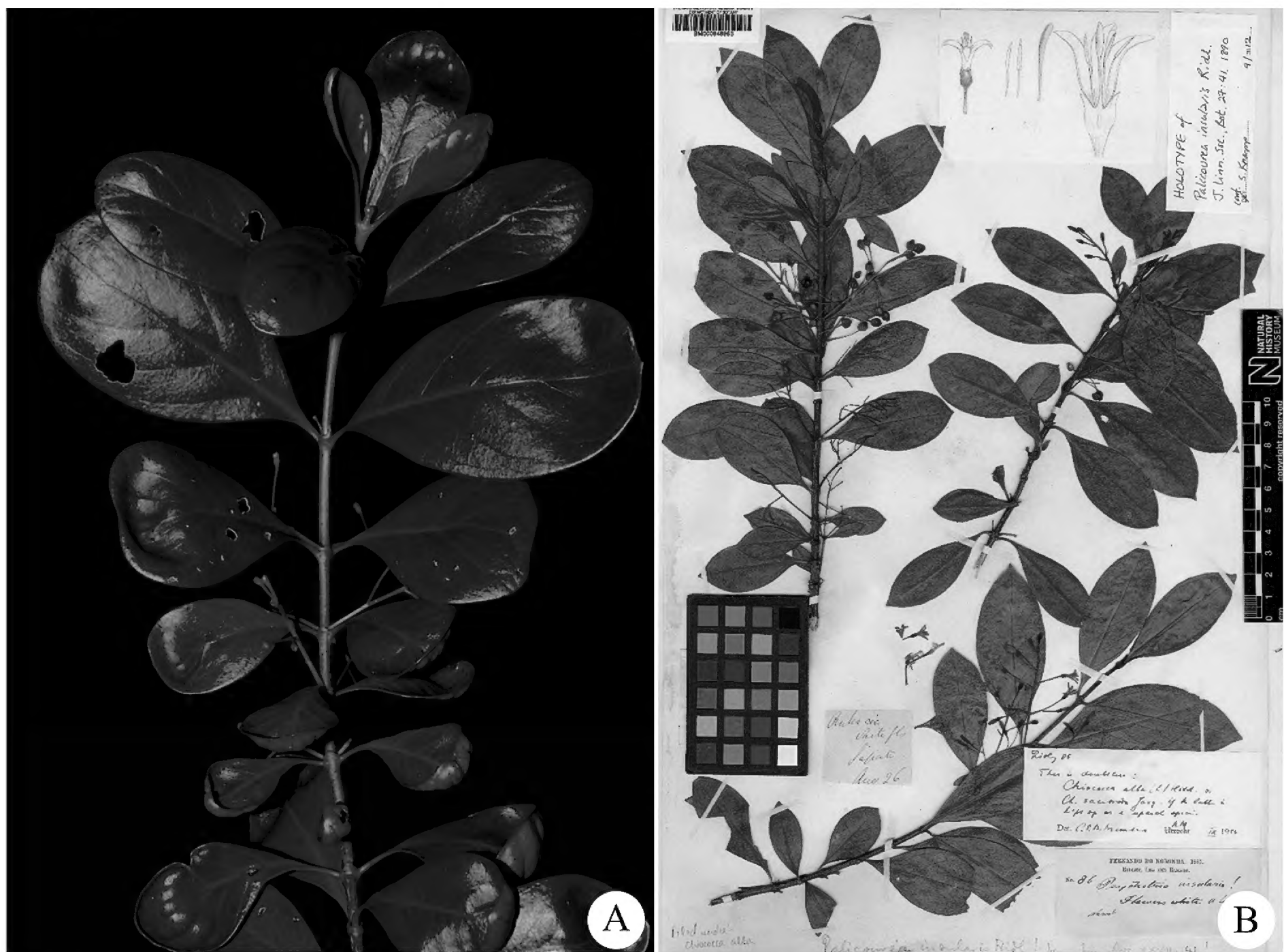


Figure 2. *Chiococca insularis*. **A.** Sample from population 1 (Figueira & Schindler 811). **B.** Type (Ridley, Lea & Ramage 86). Photographs by BS (A) and Natural History Museum (B).

older flowers, moderately reflexed; stamens 5, anthers linear acuminate; ovary 2–5-locular, stigma clavate, obtuse, greenish in fresh material. Fruits drupaceous, ellipsoid, $3\text{--}4.2 \times 3.2\text{--}4.4$ mm, immature green, becoming purple and blackish when mature, 2–5 costate at apex with persistent calyx lobes (0.8) 1.0–1.2 mm long; pyrenes 2–5.

Identification. *Chiococca insularis* can be distinguished from the other Brazilian species of *Chiococca* by its stipules not aristate; pedicels 5–17 mm long; shrub to small tree habit; and for being the only one inhabiting Fernando de Noronha.

Discussion

Zappi et al. (2013) reported that *Chiococca insularis* randomly colonized the island with little success, as Ridley (1890) mentioned the low number of individuals in his description. We found two populations of *C. insularis*, both in the southwest portion of the main island (Fig. 1), which is where it was originally reported. One population is in the forest and another in the scrub vegetation by the seashore. The forest environment presents rocky soils with exposed blocks of rock, flat to heavily undulating relief, with good drainage, about 140 m above sea level. During the dry season, the vegetation is deciduous and can be classified as a Seasonal Deciduous Forest (IBGE

2012). The forest has an irregular stratification, with two or three strata present. *Tabebuia roseoalba* (Ridl.) Sandwith is the dominant species in the canopy, reaching up to 20 m in height. In the middle layer of the forest, the most frequent species are *Guapira darwinii* (Hemsl.) E.C.O.Chagas & Costa-Lima, *Sideroxylon obtusifolium* (Roem. & Schult.) T.D. Penn., and *Guettarda platypoda* DC. The understory is richer than the other strata and is characterized by the remarkable abundance of individuals of *Capparidastrium frondosum* (Jacq.) Cornejo & Iltis. Individuals of *C. insularis* are restricted to the understory.

The appearance of the scrub vegetation along the eastern coastal slope, about 15 m above the sea, is formed by the strong trade winds which blow westward from the sea, sculpting the woody plants and making them low, with twisted branches and rigid leaves. The relief there varies from moderate to rugged, about 15 m above sea level, and the soil is rocky. Poaceae, Cyperaceae, and Rubiaceae are the richest families and cover almost all the coastal slope, except on the rocky outcrops, which are often inhabited by *Cereus insularis* Hemsl., another endemic species on the island.

According to the Italian Amerigo Vespucci, who arrived on the island in 1503, the view was of “numerous infinite trees” (Teixeira et al. 2003). Charles Darwin,

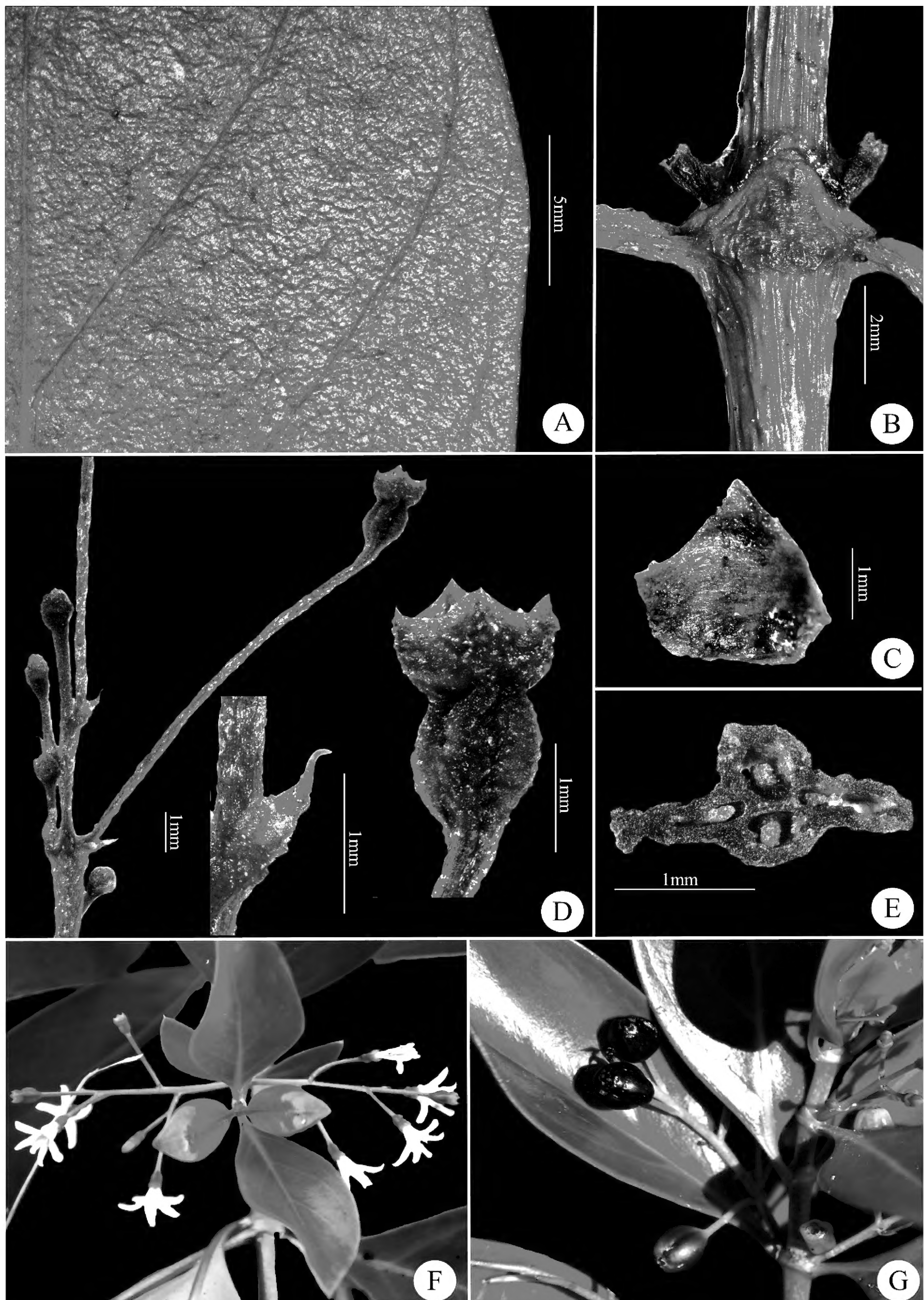


Figure 3. *Chiococca insularis*. **A.** Leaf Abaxial surface showing venation and margin. **B.** Interpetiolar stipule. **C.** Stipule internally. **D.** Inflorescence branchlet with bracteole and hypanthium enlarged. **E.** Cross-section of ovary **F.** Flowering branch. **G.** Fruits. Photographs by MF and BS (A–E) and JGJ (F, G).

during the HMS *Beagle* expedition, stayed for a few hours on the island on February 20, 1832, and stated that “the whole island is covered with forests, but due to the arid climate it has no luxuriant appearance” (Darwin 1839: 11). Almost six decades after Darwin, Ridley reported that “the western end of the island is covered with dense forest, but large trees are now not common, owing to the demand for firewood and to the strict orders for the destruction of all large trees to prevent the convicts making rafts of them on which to escape” (Ridley 1890: 5).

With these early reports, we can presume the forest physiognomy was prevalent on the main island before colonization. After its colonization in 1737 (Teixeira et al. 2003), there was a gradual increase in habitat degradation with the suppression of most of the original vegetation. The southwestern portion, where Ponta da Sapata is located, was better preserved, with the natural habitats less altered (Silva Júnior et al. 1987; Funatura 1990; Batistella 1996; Freitas 2007). This certainly contributed to the maintenance of the two populations of *C. insularis*. In both populations, but especially in the forest environment, a considerable number of fertile individuals and regenerants were found.

Therefore, we believe that *C. insularis* managed to survive in the southwest portion of the island because the site maintained adequate environmental conditions and is protected within the limits of the Parque Nacional Marinho de Fernando de Noronha. Data collection will be necessary to accurately estimate the size of populations and monitor the impact of threats.

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Authors' Contributions

MF and BS conducted the forest inventory and collected specimens in the field. MF, BS, and JGJ participated in the data collection. All authors wrote and contributed to the final version of the manuscript.

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